PROJECT **facts**

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
FEDERAL ENERGY TECHNOLOGY CENTER

ADVANCED CLEAN/EFFICIENT
POWER systems

PS023.0897M

DEVELOPING THE SECOND-GENERATION FUEL CELL — THE ENERGY RESEARCH PROJECT

PRIMARY PROJECT PARTNER

Energy Research Corporation
Danbury, CT

MAIN SITES

Santa Clara, CA
(Demonstration)

Torrington, CT
(Manufacturing)

TOTAL ESTIMATED COST

Product Design Improvement

$139,214,992

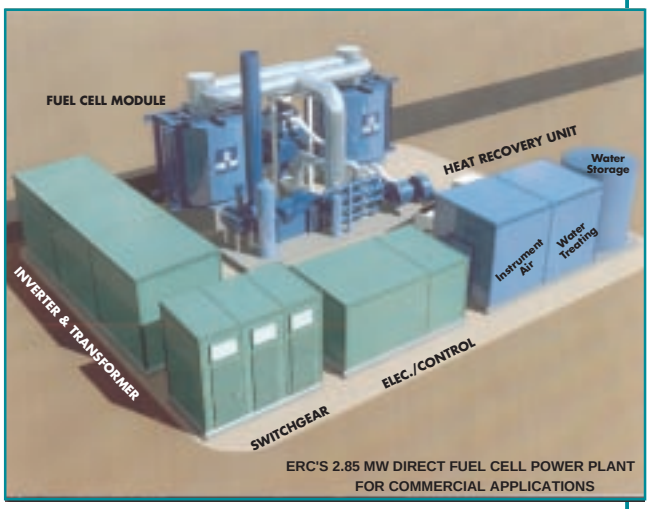
Santa Clara Demonstration

$53,388,290

COST SHARING

Product Design Improvement	
DOE	**$99,571,776**
Non-DOE	**$39,643,216**
Santa Clara Demonstration	
DOE	**$28,608,748**
Non-DOE	**$24,779,542**

Project Description



ERC'S 2.85 MW DIRECT FUEL CELL POWER PLANT FOR COMMERCIAL APPLICATIONS

The Energy Research Corporation (ERC) in Danbury, Connecticut, is one of the Nation's principal developers of stationary fuel cell power plants — a technology that is among the cleanest and most efficient available for the 21st century.

Sharing costs with the Department of Energy's Office of Fossil Energy, ERC demonstrated a carbonate fuel cell power system at the Santa Clara, California. This power plant operated on pipeline natural gas in a grid-connected mode for 4,000 hours, delivering 2,500 MWh of energy to the City of Santa Clara grid, a record for a first-of-a-kind MW size fuel cell power plant. The project was jointly funded by FETC and the SCDP (EPRI, NRECA, City of Santa Clara Electrical Department and six utilities from California and Arizona: City of Los Angeles Department of Water and Power, City of Vernon Light and Power Department, National Rural Electric Cooperative Association, Sacramento Municipal District, and Southern California Edison Company). Equipped with the Santa Clara experience, ERC is currently defining the commercial system design. ERC plans to soon implement a second demonstration of this power plant which is expected to deliver similar power levels in a plant one-tenth the size. This 2 MW second demonstration is a key milestone in the commercial entry of second-generation fuel cell technology.

Carbonate fuel cells offer higher fuel-to-electricity efficiencies than the fuel cell systems now being marketed, and they are also expected to have much lower capital costs. Quiet and virtually pollution-free, they are scheduled to become commercially available by the year 2002. The commercial system is expected to consist of 375-kilowatt stacks, with four stacks per module. Initially, the cells will be fueled by natural gas; later, as the technology advances, fuel sources could be expanded to include gas made from coal or biomass.

ERC has constructed a manufacturing facility in Torrington, Connecticut, to fabricate full-size stacks for design verification and demonstration units. The current capacity of this facility of 17 MW/yr is being expanded to 50 MW/yr to manufacture early market products. The company received an endorsement from the American Public Power Association and the Electric Power Research Institute, and a buyers' group has been actively collaborating with ERC to provide user input.

ERC has also joined forces with Fluor Daniel, Inc., a leading international supplier of services to the power industry, and MTU (Germany), an affiliate of Daimler Benz to explore worldwide opportunities.

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Developing the Second-Generation Fuel Cell — The Energy Research Project

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Project Partners

Electric Power Research Institute
Palo Alto, CA

National Rural Electric Cooperative Association
Washington, DC

The City of Santa Clara
The Sacramento Municipal Utility District
Sacramento, CA

Southern California Edison
Rosemead, CA

The Los Angeles Department of Water and Power
Los Angeles, CA

The City of Vernon, CA
Vernon, CA

Development Partners

Fuel Cell Engineering
Danbury,CT

Fuel Cell Manufacturing Corporation
Torrington, CT

Fluor Daniel, Inc.
Irvine, CA

Jacobs Applied Technology
Orangeburg, SC

Motern-Und Turbinen-Union (MTU)
Munich, Germany

Fuel Cell Commercialization Group
Washington, DC

Santa Clara Demonstration Project
Santa Clara, CA

Program Goals

Fuel cell technology is modular and lends itself well to dispersed power generation. Fuel cells could be sited at electrical substations or at the point of end use, such as a hospital or shopping mall. ERC's carbonate fuel cell system features a unique Direct Fuel Cell concept, which eliminates auxiliary equipment and simplifies the power system.

ERC's Santa Clara power unit will be the technological forerunner of the company's commercial product line. This demonstration, coupled with the company's continued product development and commercial system demonstrations, will maintain the United States' position as world leader in advanced fuel cell technology.

The program goals are to commercialize the tubular SOFC by 2002. Commercialization of the technology supports DOE goals for emissions reduction and energy security.

Project Benefits

Fuel cells have emerged as one of the most promising new power-generation technologies for the 21st century. Endorsed by President Clinton's Climate Change Action Plan, fuel cells are an environmentally clean, quiet, and highly efficient method for generating electricity and heat from natural gas and, potentially, other fuels.

Carbonate fuel cell technology is increasingly attractive because it offers several advantages over conventional power plants, as well as today's market-entry (phosphoric acid) fuel cell systems:

- Fuel-to-electricity efficiencies can exceed 60%, well above the 33% to 35% efficiencies of today's conventional power plants and the 40% to 45% efficiencies of phosphoric acid systems; when the waste heat is utilized, total thermal efficiencies can approach 85%.
- Higher operating temperatures (approximately 650°C compared with 200°C for first-generation systems) make the molten carbonate fuel cell a better candidate for combined-cycle applications (where exhaust heat is used in a steam cycle to generate additional electricity).
- The projected cost of the technology is competitive.
- The technology exceeds all current and envisioned environmental regulations, producing water and carbon dioxide as the only emissions (the amount of carbon dioxide released per unit of electricity is considerably less than current power-generating technologies, because of the higher efficiencies).